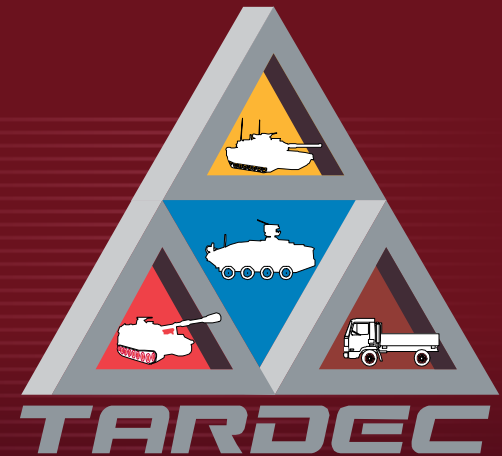




**RDECOM**



**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

## Review of Current and Future Army Needs

Dr Jay Dusenbury

Deputy for Science & Technology

U.S. Army TARDEC Force Projection Technology

- **Current and Emerging Equipment**
- **Developmental Projects**
- **Science & Technology Projects**

- The Mission of the Business Area is to Perform the Research, Development and Engineering Support for the Soldier in the Following Petroleum and Water Fields of Endeavor:

Fuel and Water Handling Equipment  
Fuel Quality and Filtration Equipment  
Water Purification and Quality Equipment  
Fuels and Lubricants Products

- We Serve as the DoD responsible Agent for All Ground Fuels and Lubricants and the Lead DoD Lab for Tactical Ground Based Water Sustainment



**Corps (aug):**  
5 1500 gph ROWPU  
(19 77Ws)

**Distribution:**  
QM Co, DSB  
(2 77Ws)  
HDC, FSB  
(3 77Ws)

# Arid

- **Water production passed back to Corps**
- **Unit distribution of bulk water to FSC and maneuver units from HDC**
- **Supply point distribution for all non-maneuver units**
- **Arid environment requires additional augmentation from EAD to receive bulk water pushes**

**Each Water point:**  
1500 gph ROWPU  
30,000 gal per day

**DSB**

# DASB

**FSB**



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# Primary Water Equipment

## Production

**ROWPU** - Reverse Osmosis Water Purification Unit (two types 600 and 3000 gph)



**600 GPH ROWPU** for Divisions and below (600 GPH on Salt water)



**3000 GPH ROWPU** for EAD (2,000 GPH on salt water) (shown with **3000 gal onion tank**)

## Distribution

**TWDS** - Tactical Water Distro System (10 mi hoseline sets)

**SMFT** - Semi-Trailer Mounted Fabric Tank (3k and 5k sizes)

**FAWPSS** - Forward Area Water Point Supply System

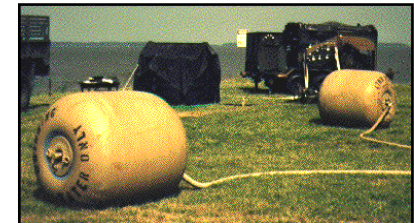
**M149 400 Gal Water Trailer**



**TWDS**--10 miles of hoseline; six 600 GPM pumps; two 20K storage tanks; two 125 gpm pumps



**M149 400 Gallon Water Trailer**



## **FAWPSS**

Six 500 gallon drums, one 125 GPM pump, and hoses



**SMFTs** two sizes (3K & 5K)

## Storage Systems

**SDS** - Storage & Distro Systems consist of 50K and 20K bags

**Onion Bag** - 3,000 gal thin skinned bag for temp storage



**SDS** come in 800K, 300K, 40K and 20K sizes complete with bags, hoses, & pumps.





# 600 GPH Reverse Osmosis Water Purification Unit



- Produce potable water that meets Tri-Service Standards from any available source
- System produces 600 gallons per hour on seawater (35,000 ppm) and 900 gallons per hour on freshwater
- Raw water intake system – strainer and raw water pump
- Clarification system – multi-media filter, cartridge filter, chemical injection pumps
- Purification system – high pressure pump, 8 6-inch reverse osmosis elements
- NBC decontamination system – activated carbon, mixed-bed ion exchange
- Disinfection by Chlorination

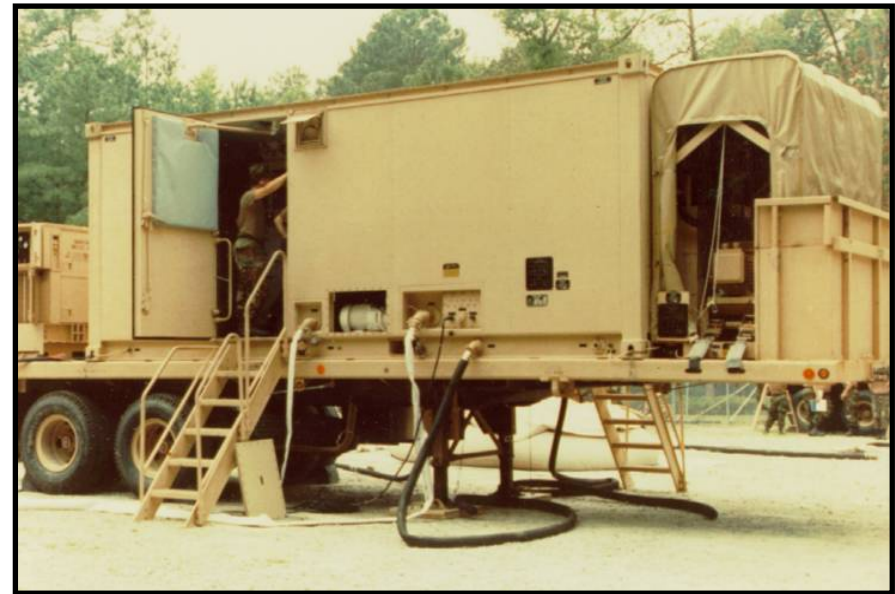




# 3000 GPH Reverse Osmosis Water Purification Unit



- Produce potable water that meets Tri-Service Standards from any available source
- System produces 2000 gallons per hour on seawater (35,000 ppm) and 3000 gallons per hour on freshwater
- Raw water intake system – strainer, raw water pump, and cyclone separator
- Clarification system – multi-media filter, cartridge filter, chemical injection pumps
- Purification system – high pressure pump, 12 8-inch reverse osmosis elements
- NBC decontamination system – activated carbon, mixed-bed ion exchange
- Disinfection by Chlorination



# New and Emerging Water Equipment

**Production---Tactical  
Water Purification System  
(TWPS) and Light Weight  
Water Purifier (LWP)**



**TWPS** is transported by HEMMT LHS and produces 1500 GPH from fresh and 1200 from salt water. Each TWPS replaces two 600 ROWPUs.



The **LWP** can be transported in the back of a HMMWV and produces 125 GPH from fresh or 75 GPH from salt water.

**Distribution--Water  
Tankrack--(HIPPO) and  
Unit Level Water  
Distribution (CAMEL) )**



The **HIPPO** is a 2000 gallon hardwall tank, mounted on a tankrack. It includes a hose reel, 125 gpm pump, and a canteen fill stand.

The **CAMEL** replaces the current M149 400 gallon water trailer in units with 5-ton trucks. It will carry 850 gallons and includes a heater and chiller.



**850 gal**





# 1500 GPH Tactical Water Purification System



- Produce potable water that meets Tri-Service Standards from any available source
- System produces 1200 gallons per hour on seawater (45,000 ppm) and 3000 gallons per hour on freshwater
- Pretreatment System - 0.2 micron Microfiltration membranes
- Desalination System - Ten (10) RO elements, two (2) FMC composite pumps, energy recovery device
- Compressed Air - Three stage compressor supplies air for automatic valves, controls and MF backflushing process
- Chemical Injection System - Sodium bisulfite (chlorine removal); Anti-scalant, and Chlorine
- Product Water Distribution - 6000 gallon storage, one 125 gpm pumps
- NBC Post-Treatment - activated carbon and ion exchange resin



**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

- Produce potable water that meets Tri-Service Standards from any available source
- System produces 75 gallons per hour on seawater (45,000 ppm) and 125 gallons per hour on freshwater
- Raw water, booster and distribution pumps run off 3kW TQG,
- Diesel driven HP pump
- Treatment by settling, ultrafiltration and Reverse Osmosis (RO)
- Disinfection by chlorine addition
- Coagulant, Sodium Bi-Sulfite and Anti-Scalant injection pumps
- GAC for removal of NBC contamination





# Military Water Purification Equipment Summary

Note: Values presented based on Seawater	LWP	600 ROWPU	3k ROWPU	A-TWPS	EUWP
• Production Rate (gph)	75	600	2,018	1,200	4,170
• Avg RO Flux (gfd)	8.9	12	13.7	7.6	11
• MF/UF Flux (gfd)	25	na	na	25	40
• RO Recovery (%)	33	31	33	37	50
• Weight (gpd/lb.)	1.09	1.40	1.88	1.26	2.62
• Cube (gpd/cu.ft.)	12.9	31.3	28.8	22.5	38.9
• C-130 Lift (gpd)	na	43,200	48,500	28,800	100,000

- Able to purify any source - lake, river, ocean, NBC contaminated - in sufficient quantities **BUT**
  - Systems have large energy (fuel) requirements
    - 20 to 50 kW-Hr/ Kgal
  - Systems have a large footprint (size/weight)
  - Systems require operational changes for certain contaminants
  - Systems are a logistics burden - large volume of consumables (filters, membranes, chemicals)

- Military Unique Requirements
- Increase Production Capacity (size/weight)
- Reduce Power
  - Energy Recovery
- Reduce Maintenance (fouling)
- Minimize Logistics
- Maximize Reliability
- Evaluation of Commercial Products
  - RO Pretreatment Studies
    - UF/MF (PDVF)
    - Improved Filtration & Coagulation
    - Automated Screens
  - Seawater materials
- Cyanide, Arsenic, & Other Difficult to Remove Contaminants
- RO/GAC – nerve agent removal
- Ion Exchange (iodine)
- New Polishing Technologies
- Improve Palatability Water Provided
- Water Reuse and Recycle
- Packaged Water





- *Title:* Membrane Chemical Agent Rejection Test
- *Exp. Start Date:* 2Q FY08
- *Exp. End Date:* 3Q FY08
- *Purpose:*
  - To determine if newly developed high organic rejection reverse osmosis membrane will remove chemical agents from water effectively enough to meet drinking water standards.
  - Will test chemical agents at a challenge concentration
  - Will test under conditions simulating the LWP operating conditions
  - With ECBC will leverage testing opportunity to evaluate Agentase, agent monitoring device
- *TRL Dem'd:* TRL 5
- *Where:* Edgewood Chemical Biological Center (ECBC)
- *BL/RDEC Participants:* ECBC, Joint Service Water Agent Monitor (JSWAM) testing.
- *Other Participants:*
- *Comments:* Test stand has undergone shake out test runs at TARDEC. It is currently on site at ECBC. Testing is expected to be started in May 08 and completed by June 08, with final test results submitted in 3Q FY08.



- **System Housed in a 20' x 20' x 8' ISO Container**
  - **Complies with Intermodal Shipping requirements**
  - **Faster Set-up and Start-up**
  - **Environmentally Safe by Keeping Contaminates Out**
- **Capability to produce 400 to 500 one liter bottles per hour**
- **Daily production planned to be 3500 to 5500 one liter bottles**
- **Supports requirements for 1800 personnel at three liters of drinking water per day**
- **Generator Set Allows for Operation in Remote Areas**
- **Can Add Systems for Higher Quantity Production if Needed**
- **Small Enough to be Handled by Material Handling Equipment**
  - **Weights 15000 pounds**
- **Pre-form Bottles and all Other Supplies Delivered in 20' x 20' x 8' ISO Containers**
- **Can be Located Close to Water Purification Site**
  - **Reduces Risk of Sabotage**
  - **Maintains Quality of Water**
  - **Easier for Field Commanders to Control Operations**



Objective: Reduce the sustainment requirement and logistics footprint associated with water production and distribution.

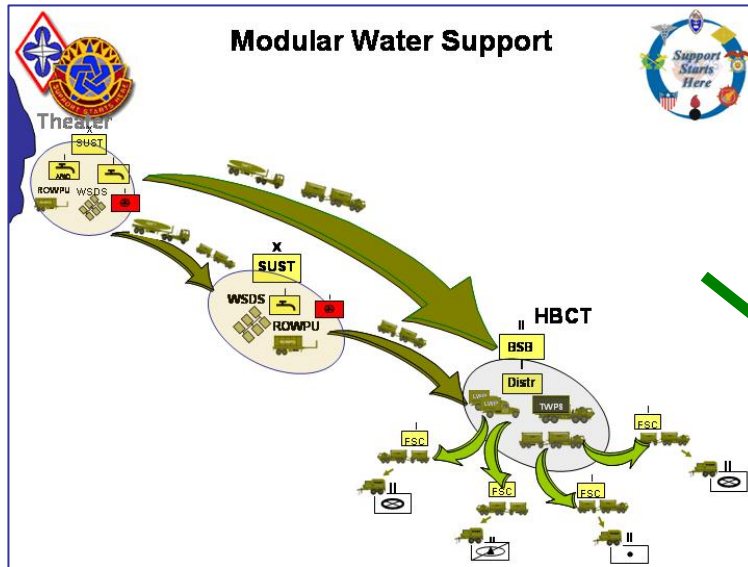
Thrust Area 1: Create low-power, highly-efficient revolutionary technologies enabling embedded water purification/desalinization

- ◆ Bio-inspired concepts (forward osmosis)
- ◆ Reverse osmosis - re-think the whole technology
- ◆ Mixed Oxidant Technology
- ◆ Capacitive Deionization

Thrust Area 2: Create innovative water “generation” technologies

- ◆ Water from air
- ◆ Water recovery from exhaust
- ◆ Humidity concentration
- ◆ Water recycle/reuse





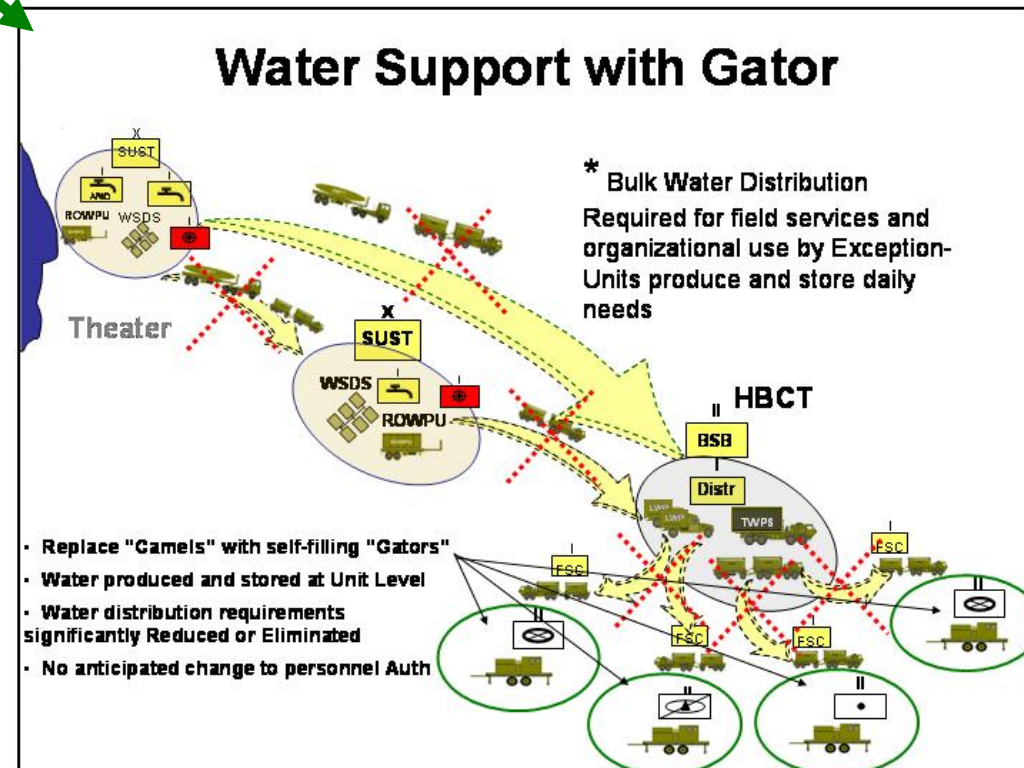
### Significant Change:

Distribution based resupply to  
“self sufficiency” at the Unit Level

\* Water Distribution with Brigade Support Battalion (BSB) HIPPOs and TWPS for exceptional requirements

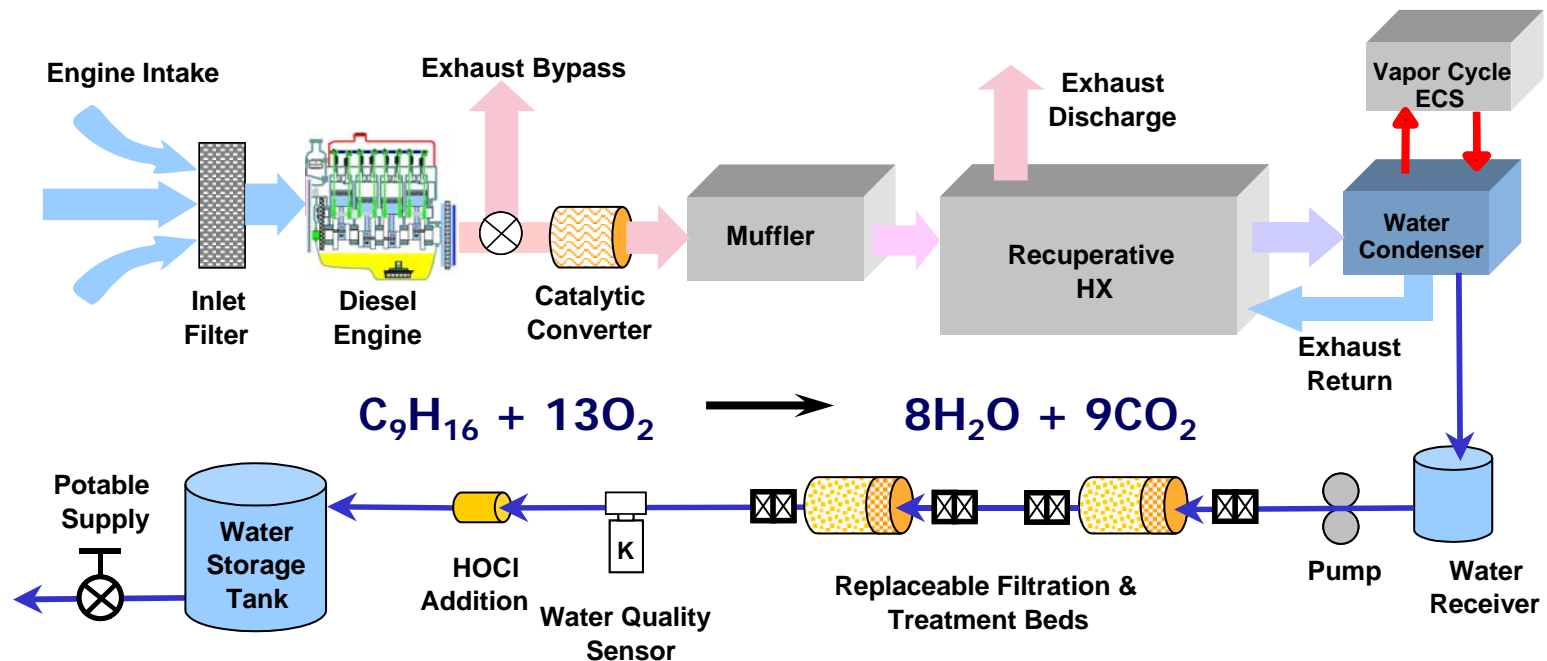
## CONOPS Water From Air

- Gator replaces Camel
  - ✓ Produce 500 Gal per Day
  - ✓ Stores 500 gallons
- Gator provide potable water requirements at the unit level
- Significantly reduces purification requirements within the BCT and EAB
- Significantly reduces distribution requirements in within the BCT and EAB



## Concept

- Combustion of 1 gallon of Fuel produces 1 gallon of water
- Capture water from any engine in the battlespace
- Filtration train: 2 carbon beds & 1 resin bed
  - All inorganics/ metals below standard:
  - Organic Results TOC 0.1 ppm,
- pH 6.8 and conductivity 6.1  $\mu\text{S}/\text{cm}$ .





# On-Board Water Recovery Unit



## Testing

- HMMWVs delivered to ATC Dec 05
- Unpayloaded system completed testing on 1 mile loop paved course, Jan 06
- Payloaded, secondary, and cross-country testing completed, Mar – May 06



## Program Status:

- TRL 6, demonstrated water recovery & purification at 0.5 to 0.6 gallons water per gallon of fuel
- System transition limited by size, weight, and filter requirements
- Army should continue active review of technology developments for solutions to identified challenges

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## Vehicle-Integrated Breadboard Demonstrator

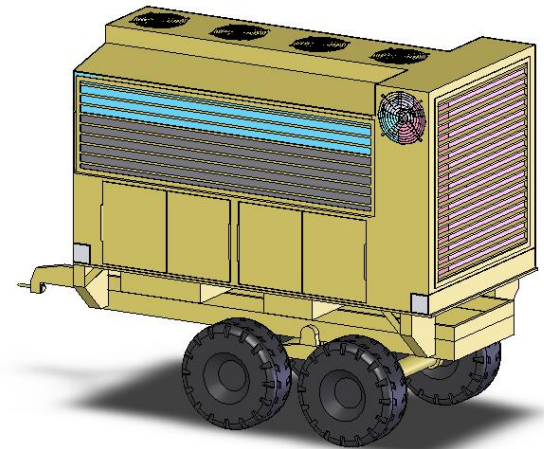
- TRL 5: Demonstrator designed, fabricated and operation verified in realistic environment through testing at ATC.
- Designed for mounting on a HEMTT.
- Production goal of 5 gallons of water per gallon of fuel.
- Demonstrated at the Platform System Demonstration August 06.
- Completed Environmental Chamber Test at ATC.
  - Nominal water production 2 gph.
  - Produced 1.8 gph of water at design point; produced up to 3.6 gph of water depending on condition.
  - Produced 1.6 gallons of water per gallon of fuel at design point; produced up to 6 gallons of water per gallon of fuel depending on condition.
- Road testing completed.
  - Successfully completed 1200 miles on various terrains.
- Sand and Dust testing completed.





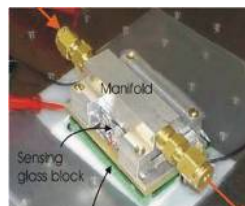
## Phase III - Develop a TRL 6 + militarized 7.5 ton trailer mounted Water from Air System

- Designed to provide self-filling water capability equivalent to the CAMEL
- Nominal water production of 500 gpd.
- Nominal minimum fuel efficiency of 2 gallons of water per gallon of fuel and 5 gallons of water per gallon of fuel at design conditions.
- Field testing to occur with soldiers to evaluate military utility.
- CONOPS, Economic Model and Transition Strategy prepared/updated in conjunction with system development.





**Current Monitoring**



**Future Monitoring**

**Schedule & Cost**

MILESTONES	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15
Develop hand-held SAWS, RAMAN, AChE enzyme tech			5						
Develop basic on-line monitor				5					
Integrate and evaluate hand-held technology in a demonstrator					6				
Integrate and test basic on-line							6		
Develop advanced on-line sensors						5			
Integrate and evaluate advanced on-line tech									
Automated control with on-line sensors									

## Purpose:

- To provide enhanced real-time monitoring capability for Site Reconnaissance, Water Purification Equipment Operation, and Water Certification

## Product:

- Hand-held biological and chemical contaminant detector.
- Inline real time monitoring of water quality parameters
- Monitor and report water quality, quantity & location

## (Warfighter) Payoff:

- Address current deficiencies in the capability of the WQAS-P and WQAS-PM to monitor contaminants identified in TB MED 577 & Tech Guide 230
- Enable the fresh water by-pass to double water purification system production on suitable sources.
- Reduce microbiological water quality testing from 24 hours to less than 1 hour
- Provide real time monitoring of GAC during NBC operations.

**THE WORLDS ULTIMATE WEAPON RUNS ON WATER...  
EVERYTHING ELSE RUNS ON FUEL.**

